Survival Factors
Airbag Safety Study Factual Report
June 9, 2010

Location:	Boyceville, WI
Aircraft Type:	Cirrus SR-22
Accident Date:	August 5, 2006
Accident Time:	1140 CST
Accident Number:	CHI06FA218
Airbag Equipped:	Yes

Group Members:

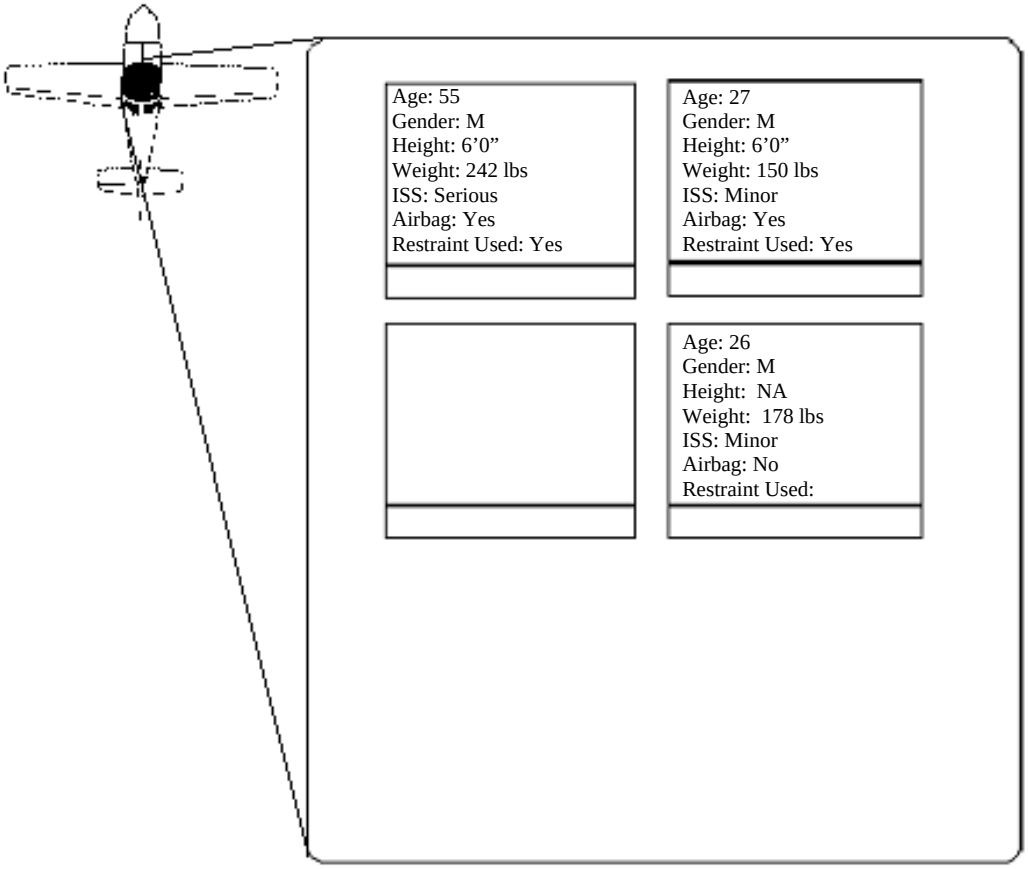
NTSB Group Chairman:
Rob Molloy, NTSB

Additional Members:
Jason Fedok, NTSB
Mitch Gallo, NTSB
Larry Landis, FAA
Christine Soucy, FAA
Tom Barth, AmSafe
Brannon Mayer, Cirrus
Aaron Wedge, Cirrus
Jana Price (did not launch to scene)

Summary:

On August 5, 2006, at 1140 central daylight time, a Cirrus SR22, N658CD, received substantial damage on impact with terrain during approach to runway 26 (3,300 feet by 60 feet, asphalt) at Boyceville Municipal Airport, Boyceville, Wisconsin. Visual meteorological conditions prevailed at the time of the accident. The 14 CFR Part 91 instructional flight was not operating on a flight plan. The pilot (left front seat occupant) received serious injuries. The certified flight instructor (right front seat occupant) and passenger (right rear seat occupant) received minor injuries. The flight originated from Duluth International Airport, Duluth, Minnesota, at 1015, and was en route to Chippewa Valley Regional Airport, Eau Claire, Wisconsin.

Seating Chart:



Accident Documentation:

Primary Flight Display/Multifunction Display

The primary flight display (PFD) and multifunction display (MFD) were removed from the wreckage and were downloaded and analyzed by Safety Board staff. The PFD samples data every 200 milliseconds and writes the data to memory once per second. GPS position data is recorded once every 6 seconds. The last sample captured by the PFD indicated a longitudinal (forward) g-force of +1.36 g and a vertical (downward) force of -2.17 g (that is, -1.17 g beyond the nominal gravitational force). For the lateral (side-to-side) forces, the final 3 samples were at 0, -1.2 g (left) and +1.48 g (right), which would suggest a rapid rotation around the lateral axis. It is important to note that the peak forces on the airplane could have been greater than what was recorded due to the relatively slow sampling rate of the system, or if the system stopped recording during the crash sequence.

Wreckage Documentation

The airplane was located approximately 350 feet to the right (west) of the approach end for runway 26 in a bean field. The main wreckage, which consisted of the fuselage, wings, empennage, and engine was at the western edge of a 150 foot long ground scar located on a 270 degree azimuth from the point of impact. There were three depressions along the length of the ground scar. The eastern end of the ground scar was near an area

of debris from the left wing tip and pieces of the upper wing skin, followed by a second depression approximately 50 feet from the first ground scar along the 270 degree heading. The second depression was approximately 10 feet by 15 feet and contained pieces of engine cowling. Adjacent to the second depression were tree branches cut approximately 60 degrees relative to horizontal. The western most depression contained the main wreckage oriented on a tail to nose heading of approximately 150 degrees with the attached engine, fuselage, wings, and empennage.

The left wing (the wing is a one piece wing) exhibited wrinkles oriented from the inboard leading edge, forward of the fuel cap, to the outboard direction approximately 3/4 chord at a 45 degree angle relative to the wing chord. The left wing tip was separated from the wing which was fractured about 8 feet inboard from the wing tip. The left wing also exhibited aft wise deformation. The right wing was undamaged. Both wing flaps were attached to their wings. The fuselage was separated from the wing assembly and was resting on its right side. The fuselage separation traversed the bottom of the A-pillars to the left cabin door lower aft corner, across the floor between the front and rear seats, and to the lower aft corner of the right cabin door.

The nose landing gear was fractured from the gear mount at the upper end of the strut. The nose landing gear tire and wheel were attached to the strut. The left main landing gear was attached to the wing. The right main landing gear was separated approximately midpoint of the axle fitting and the strut upper end fitting. The lower section of the right main landing gear strut was separated from the wing. The right main landing gear tire and wheel assembly remained attached to the lower section of the separated strut.

The metal firewall shield was wrinkled and both bottom firewall-to-engine frame mounts were damaged. The bottom left firewall-to-engine mount was deformed outboard, and the left mount was crushed inward deforming each side of the mount to the outboard and inboard direction, respectively. The engine frame was deformed to the right approximately 5-10 degrees. The top left engine frame tube was fractured through near the firewall mount. The right engine frame tube that attaches to the nose wheel mount was fractured through. All of the engine mount bolts were intact and not fractured.

Figure 1: A photograph showing the damage to the aircraft. The two first row seats are visible in this photograph.

Seats

Left Front Seat:
Both the left and right front seats were attached to the spar tunnel. The left front seat is shown in figure 2. The aft, outboard seat slider was found approximately 4.25” from the aft end of the seat rail. The inboard slider was found approximately 3.875” from the aft end of the inboard seat rail. The left front energy absorption module (EAM), which has a nominal thickness of 3.5”, exhibited crushing damage across its leading edge from its left and right corners. The crushing extended across the top, from front to rear, approximately 2.0” aft from the left front corner and right front corner and approximately 6.0” aft across the middle. The left front energy absorption module's leading edge was approximately 2.75” thick. The following information was written on the EAM: 102105, 001121-3, 14152-004, 10-21-05.

Right Front Seat
The right front seat is shown in figure 3. The inboard and outboard seat rail sliders were found 6.5” forward of the aft end of the seat rails. The right front EAM exhibited crushing damage across its leading edge from its left to right corner. The crushing extended across the top from front to rear approximately 3.0” aft from the left front corner to approximately 6.0” aft from the right front corner. The right front energy

absorption module's leading edge was measured to be approximately 2.75” thick. There was also a minor indentation/impression in the location of the seventh (from rear) adjustment hole of the outboard seat rail. There was a corresponding shallow indentation in the thin aluminum seatpan above the EAM. The following information was written on the EAM: 102105, 001114, 14152-004, 10-21-05

Left Aft Seat

The left aft seat was found near the wreckage but disconnected from the fuselage. The seat was identified through fracture matching with the piece of composite floor material and part number comparison with an exemplar airplane.

Right Aft Seat

The right aft seat was found near the wreckage but disconnected from the fuselage.There was no damage to the seat with the exception of the outboard seatpan seat pin that had been torn from the aluminum seat pan. The inboard seatpan seat pin was not damaged and contained a small strip of composite flooring material. The energy absorbing foam (nominal thickness: 2.5”) inside the seatpan showed evidence of crushing to about 0.5” in the center of the leading edge.

Seat Numbers:

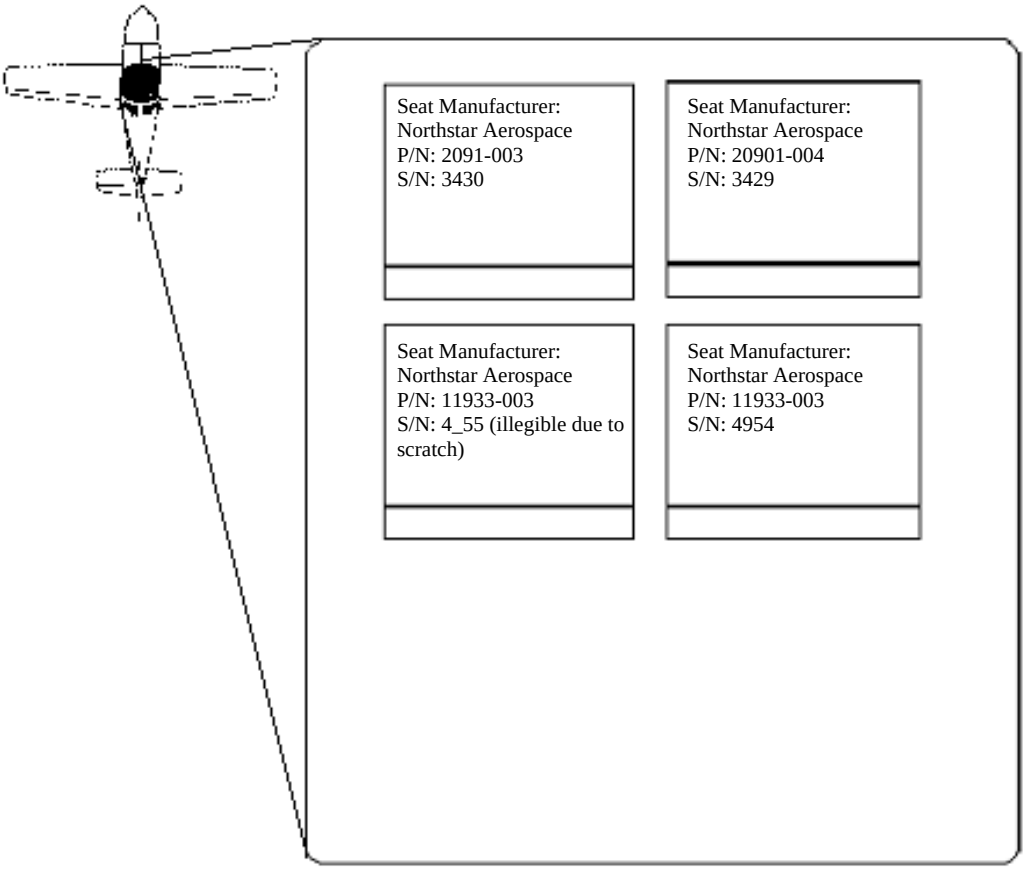


Figure 2. Left front seat

Figure 3. Right front seat.

Restraints:

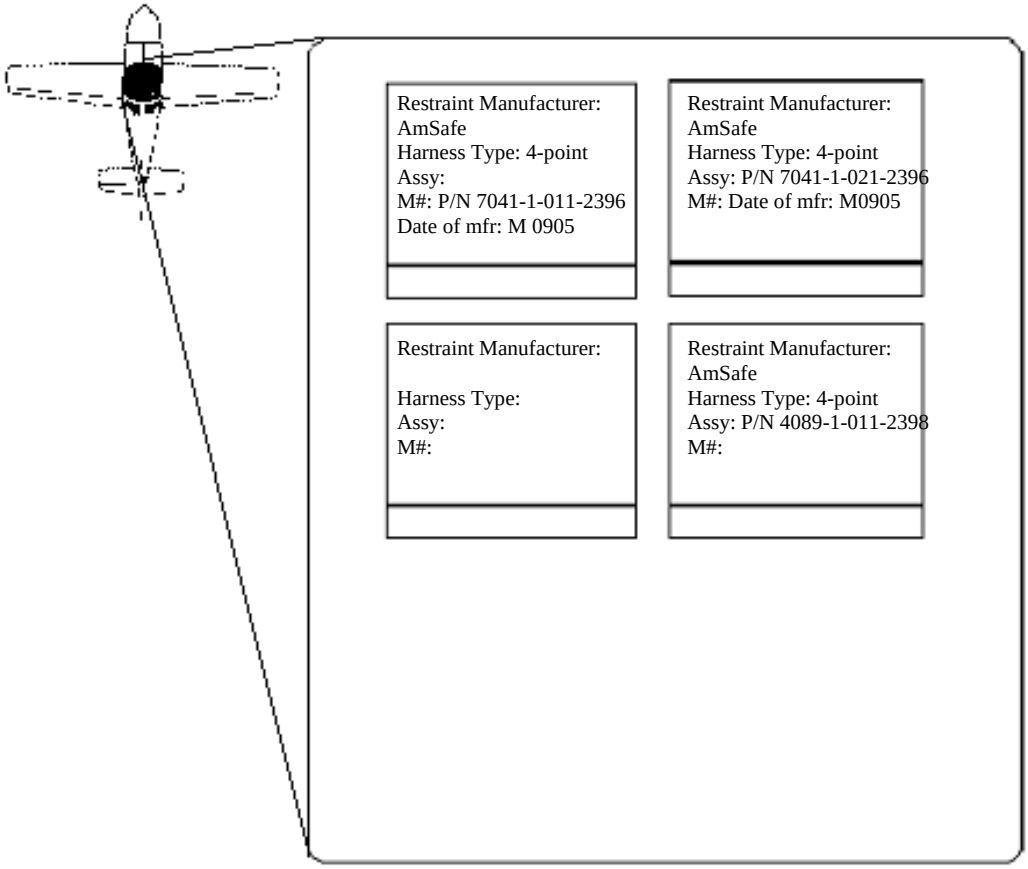
The Cirrus SR-22 has 4-point restraints in all four seating positions.

Left Front Seat:
The outboard restraint was adjusted so that there was approximately 21.5" of webbing between the buckle and the seatbelt attachment point. The inboard restraint was adjusted so that there was approximately 22.5" of webbing between the connector tongue and the seatbelt attachment point. Load bar marks were noted on both portions of webbing that were in contact with the load bar within the webbing adjusters. The load bar witness marks were more noticeable on the inboard restraint than the outboard restraint.

Right Front Seat
The outboard restraint was adjusted so that there was approximately 16" of webbing between the connector tongue and the seatbelt attachment point. The inboard restraint was adjusted so that there was approximately 17.5" of webbing between the buckle and the seatbelt attachment point. Load bar marks were noted on both portions of webbing that were in contact with the load bar within the webbing adjusters. The load bar witness marks were more noticeable of the outboard restraint than the inboard restraint.

Aft Seats
The two shoulder harnesses were secured to a single inertia reel mounted on the aft portion of the cabin. The lapbelt portions of the restraint were each secured to a fixed bracket on the floor on either side of the seat. The shoulder harnesses were not equipped with an airbag. The buckles and connector tongues were functional. The inertia reel locked repeatedly when test pulled by hand. It was removed and retained for examination. On the right aft side, load bar witness marks were noted on the outboard lapbelt approximately 9" from the outboard floor attachment.

Restraint Numbers:



Airbags:

The airplane had AmSafe airbags installed in the outboard shoulder harnesses of the four-point restraints for both front seats. Both of the airbags deployed in the accident.

Left Front Seat

The left front seat airbag, shown in figure 2, had an approximately 4-6" in diameter blood spot on the occupant side of the bag. There was a smaller spot on the instrument side of the bag that matched the position of the larger spot and may have resulted from blood soaking through the airbag. There were no other marks or scuffs on the airbag. The upper vent hole was slightly frayed at its top (1200 position) and the lower vent hole exhibited stress but no fraying was documented.

Right Front Seat

The right front seat airbag contained no cuts, tears, abrasions, or blood stains. The top circular vent showed minor fraying while the bottom vent showed more significant fraying and squaring. The bag's seams were not damaged or pulled. The seat cover was removed and the individual components of the airbag inflation system were examined and found to be in normal condition.

Medical/Autopsy Information:

The male occupant, the pilot, in the 1st row on the left side was transferred to Regions Hospital (640 Jackson Street, St. Paul, MN 55101) via Lifelink helicopter. The occupant in the 1st row, right side and the occupant in the 2nd row, right side were treated at Red Cedar Medical Center (2321 Stout Road, Menomonie, WI 54751). The occupant seating location, gender, age, height, weight and injuries summarized from the medical records are listed in Table 1 below.

Table 1: A table of the occupant injury description and classification.

Occupant Location	Gender	Age	Height	Weight	Description Of Injuries	Injury Classification
1st Row, Left	M	55	6’	242 lbs	Open left pilon fracture with associated fibula fracture; left non-displaced radial head fracture; Minimally displaced fracture of the posterior medial most aspect of the right third, fourth, fifth, and likely second and sixth ribs at the level of the costovertebral junction. Lateral mildly displaced fractures of the right second, fourth, fifth, sixth, and seventh ribs. Mildly displaced anterolateral fractures of the left fourth, and fifth ribs. small abrasions and contusions to right temple; bruising over left eyelid; 3 cm laceration to chin; small contusions scattered on right chest wall; contusion on left forearm	Serious
1st Row, Right	M	27	6’	150 lbs	Left forehead laceration; left upper arm abrasion; left posterior iliac abrasion;	Minor

					lower cervical neck strain[1]	
2nd Row, Right	M	26	n/a	178 lbs	Left anterior tibial abrasion; right iliac crest abrasion	Minor

[1] This occupant self-reported additional injuries that he termed “trivial”. These injuries included a bruise above his right eye, a bruise on his right shoulder and right hip that he attributed to the restraint and bruising to his backbone. He also noted bumps on his legs and right arm.